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(54) **ICE WORTHY JACK-UP DRILLING UNIT WITH GAS AGITATION AND LEG ICE SHIELDS**

EISTAUGLICHE HUBBOHREINHEIT MIT GASERREGUNG UND PFEILEREISSCHILD

UNITÉ DE FORAGE AUTO-ÉLÉVATRICE SPÉCIALEMENT ADAPTÉE À LA GLACE AVEC AGITATION DE GAZ ET PROTECTIONS DE JAMBE CONTRE LA GLACE

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Description

FIELD OF THE INVENTION

[0001] This invention relates to mobile offshore drilling units, often called "jack-up" drilling units or rigs that are used in shallow water, typically less than 400 feet, for drilling for hydrocarbons.

BACKGROUND OF THE INVENTION

[0002] In the never-ending search for hydrocarbons, many oil and gas reservoirs have been discovered over the last one hundred and fifty years. Many technologies have been developed to find new reservoirs and resources and most areas of the world have been scoured looking for new discoveries. Few expect that any large, undiscovered resources remain to be found near populated areas and in places that would be easily accessed. Instead, new large reserves are being found in more challenging and difficult to reach areas.

[0003] One promising area is in the offshore Arctic. However, the Arctic is remote and cold where ice on the water creates considerable challenges for prospecting for and producing hydrocarbons. Over the years, it has generally been regarded that six unprofitable wells must be drilled for every profitable well. If this is actually true, one must hope that the unprofitable wells will not be expensive to drill. However, in the Arctic, little, if anything, is inexpensive.

[0004] Currently, in the shallow waters of cold weather places like the Arctic, a jack-up or mobile offshore drilling unit (MODU) can be used for about 45-90 days in the short, open-water summer season. Predicting when the drilling season starts and ends is a game of chance and many efforts are undertaken to determine when the jack-up may be safely towed to the drilling location and drilling may be started. Once started, there is considerable urgency to complete the well to avoid having to disconnect and retreat in the event of ice incursion before the well is complete. Even during the few weeks of open water, ice floes present a significant hazard to jack-up drilling rigs where the drilling rig is on location and legs of the jack-up drilling rig are exposed and quite vulnerable to damage.

[0005] Jack-up rigs are mobile, self-elevating, offshore drilling and workover platforms equipped with legs that are arranged to be lowered to the sea floor and then to lift the hull out of the water. Jack-up rigs typically include the drilling and/or workover equipment, leg-jacking system, crew quarters, loading and unloading facilities, storage areas for bulk and liquid materials, helicopter landing deck and other related facilities and equipment.

[0006] A jack-up rig is designed to be towed to the drilling site and jacked-up out of the water so that the wave action of the sea only impacts the legs which have a fairly small cross section and thus allows the wave action to pass by without imparting significant movement to the jack-up rig. However, the legs of a jack-up provide little defense against ice floe collisions and an ice floe of any notable size is capable of causing structural damage to one or more legs and/or pushing the rig off location. If this type of event were to happen before the drilling operations were suspended and suitable secure and abandon had been completed, a hydrocarbon leak would possibly occur. Even a small risk of such a leak is completely unacceptable in the oil and gas industry, to the regulators and to the public.

[0007] Thus, once it is determined that a potentially profitable well has been drilled during this short season, a very large, gravity based production system, or similar structure may be brought in and set on the sea floor for the long process of drilling and producing the hydrocarbons. These gravity based structures are very large and very expensive, but are built to withstand the ice forces year around.

[0008] US2008/237175A1 describes a jack up rig with legs and jack up devices and with a hull having a deck and a surface which slopes inwardly from top to bottom, a feature which may help deflect ice, though the document makes no reference to the deflection of ice. In terms of claim 1, this document discloses a jack-up rig for drilling for hydrocarbons, a flotation hull, three truss form legs and a jack-up device associated with each leg.

[0009] FR2528466A1 describes ice shields around the legs of a rig. NL7705518 describes the gas agitation near the legs of a rig to reduce issues with ice.

BRIEF SUMMARY OF THE DISCLOSURE

[0010] The invention more particularly relates to an ice worthy jack up rig, as defined by claim 1, for drilling for hydrocarbons in potential ice conditions in offshore areas including a flotation hull having a relatively flat deck at the upper portion thereof. The flotation hull further includes an ice bending shape along the lower portion thereof and extending around the periphery of the hull where the ice bending shape extends from an area of the hull near the level of the deck and extends downwardly near the bottom of the hull along with an ice deflecting portion extending around the perimeter of the bottom of the hull to direct ice around the hull and not under the hull. The rig includes at least three truss form legs that are positioned within the perimeter of the bottom of the hull wherein the legs are arranged to be lifted up off the seafloor so that the rig may be towed through shallow water and also extend to the sea floor and extend further to lift the hull partially or fully out of the water. A jack up device is associated with each leg to both lift the leg from the sea bottom so that the ice worthy jack up rig may float by the buoyancy of the hull and push the legs down to the seafloor and push the hull partially up and out of the water when ice floes threaten the rig and fully out of the water when ice is not present. The rig includes leg ice shields to protect the truss form legs from ice and a gas agitation system to agitate the water near the legs and

reduce issues with ice near the legs.

[0011] The invention further relates to a method for drilling wells in ice prone waters, as defined by claims 8 and 12. The method includes providing a flotation hull having a relatively flat deck at the upper portion thereof and an ice bending shape along the lower portion thereof where the ice bending shape extends from an area of the hull near the level of the deck and extends downwardly near the bottom of the hull and an ice deflecting portion extending around the perimeter of the bottom of the hull to direct ice around the hull and not under the hull. At least three truss form legs are positioned within the perimeter of the bottom of the hull where each leg comprises a plurality of vertically oriented posts connected by cross members and ice shields are arranged between the posts to protect the cross members from ice. Each leg is jacked down in a manner that feet on the bottom of the legs engages the sea floor and lifts the hull up and fully out of the water when ice is not threatening the rig while the rig is drilling a well on a drill site. The hull is further lowered into the water into an ice defensive configuration so that the ice bending shape extends above and below the sea surface to bend ice that comes against the rig to cause the ice to submerge under the water and endure bending forces that break the ice where the ice flows past the rig. The water is agitated near the legs and reduce issues with ice near the legs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] A more complete understanding of the present invention and benefits thereof may be acquired by referring to the follow description taken in conjunction with the accompanying drawings in which:

Figure 1 is an elevation view of a first embodiment of the present invention where the drilling rig is floating in the water and available to be towed to a well drilling site;

Figure 2 is an elevation view of the first embodiment of the present invention where the drilling rig is jacked up out of the water for open water drilling through a moon pool;

Figure 3 is an elevation view of the first embodiment of the present invention where the drilling rig is partially lowered into the ice/water interface, but still supported by its legs, in a defensive configuration for drilling during potential ice conditions;

Figure 4 is an enlarged fragmentary elevation view showing one end of the first embodiment of the present invention in the Figure 3 configuration with ice moving against the rig;

Figure 5 is a top view of a leg of the drilling rig with a first embodiment of the leg ice shields in place; and

Figure 6 is a top view of a leg of the drilling rig with a second embodiment of the leg ice shields in place.

DETAILED DESCRIPTION

[0013] Turning now to the detailed description of the preferred arrangement or arrangements of the present invention, it should be understood that the inventive features and concepts may be manifested in other arrangements and that the scope of the invention is not limited to the embodiments described or illustrated. The scope of the invention is intended only to be limited by the scope of the claims that follow.

[0014] As shown in Figure 1, an ice worthy jack-up rig is generally indicated by the arrow 10. In Figure 1, jack-up rig 10 is shown with its hull 20 floating in the sea and legs 25 in a lifted arrangement where much of the length of the legs 25 extend above the deck 21 of the hull 20. On the deck 21 is derrick 30 which is used to drill wells. In the configuration shown in Figure 1, the jack-up rig 10 may be towed from one prospect field to another and to and from shore bases for maintenance and other shore service.

[0015] When the jack-up rig 10 is towed to a drilling site in generally shallow water, the legs 25 are lowered through the openings 27 in hull 20 until the feet 26 at the bottom ends of the legs 25 engage the seafloor 15 as shown in Figure 2. In a preferred embodiment, the feet 26 are connected to spud cans 28 to secure the rig 10 to the seafloor. Once the feet 26 engage the seafloor 15, jacking rigs within openings 27 push the legs 25 down and therefore, the hull 20 is lifted out of the water. With the hull 20 fully jacked-up and out of the water, any wave action and heavy seas more easily break past the legs 25 as compared to the effect of waves against a large buoyant object like the hull 20. Well drilling operations may commence in the ordinary course while there is no ice in the area.

[0016] The ice-worthy jack-up drilling rig 10 is designed to resist ice floes by assuming an ice defensive, hull-in-water configuration as shown in Figure 3. In Figure 3, ice tends to dampen waves and rough seas, so the sea surface 12 appears less threatening, however, the hazards of the marine environment have only altered, and not lessened. When the ice-worthy jack-up rig 10 assumes its ice defensive, hull-in-water configuration, the hull 20 is lowered into the water to contact same, but not to the extent that the hull 20 would begin to float. A significant portion of the weight of the rig 10 preferably remains on the legs 25 to hold the position of the rig 10 on the drill site against any pressure an ice flow might bring. As shown in Figure 4, the rig 10 is lowered so that inwardly sloped, ice-bending surface 41 bridges the sea surface 12 or ice/water interface to engage any floating ice that may come upon the rig 10.

[0017] The sloped ice-bending surface 41 runs from shoulder 42, which is at the edge of the deck 21, down to neckline 44. Ice deflector 45 extends downward from neckline 44. Thus, when an ice floe, such as shown at 51 comes to the rig 10, the ice-bending surface 41 causes the leading edge of the ice floe 51 to submerge under

the sea surface 12 and apply a significant bending force that breaks large ice floes into smaller, less damaging, less hazardous bits of ice. For example, it is conceivable that an ice floe being hundreds of feet and maybe miles across could come toward the rig 10. If the ice floe is broken into bits that are less than twenty feet in the longest dimension, such bits are able to pass around the rig 10 with much less concern.

[0018] In Figures 2, 3 and 4, the present invention provides a first additional ice defensive aspect where air blower 35 is arranged to blow air down through hoses 36 to the spud cans 28. The spud cans 28 include holes or diffusers to release air bubbles to agitate the water around the legs 25. The agitated water is stirred to prevent ice from forming on the legs and creates a natural flow away from the legs. With the gas agitation system, it may be practical to maintain the rig 10 in the configuration shown in Figure 2 when ice first becomes a concern rather than immediately begin the involved process of transitioning the rig 10 from the configuration shown in Figure 2 to the defensive, hull-in-water configuration shown in Figure 3. This may be helpful if weather forecasts suggest possible ice conditions for a period of time followed by storms and heavy seas (in which the out of the water configuration shown in Figure 2 is preferred).

[0019] In addition to the gas agitation, leg ice shields 32 are attached between vertical posts 31 of the legs to provide a second additional ice defensive feature for the present invention. In Figure 5, the leg ice shields 32 are bowed to provide a rounded shape to steer any ice around the legs. In Figure 6, the leg ice shields 33 are relatively flat. As shown in Figures 2, 3 and 4, the leg ice shields 32 or, alternatively 33, are preferably positioned on the legs to extend above, below and across the waterline 12 but not necessarily cover the entire vertical length of each leg 25.

[0020] Ice has substantial compressive strength being in the range of 4 to 12 MPa, but is much weaker against bending with typical flexure strength in the range of 0.3 to 0.5 MPa. As shown, the force of the ice floe 51 moving along the sea surface 12 causes the leading edge to slide under the sea surface 12 and caused section 52 to break off. With the ice floe 51 broken into smaller floes, such as section 52 and bit 53, the smaller sections tend to float past and around the rig 10 without applying the impacts or forces of a large floe. It is preferred that ice not be forced under the flat of bottom of the hull 20 and the ice deflector 45 turns ice to flow around the side of the hull 20. If the ice is really thick, the ice deflector 45 is arranged to extend downwardly at a steeper angle than ice-bending surface 41 and will increase the bending forces on the ice floe. At the ice deflector 45, an ice deflector is positioned to extend down from the flat of bottom of the hull 20. In an optional arrangement, the turn of the bilge is the flat of bottom at the bottom end of the ice deflector 45.

[0021] To additionally resist the forces that an ice floe may impose on the rig 10, the feet 26 of the legs may be arranged to connect to cans 28 set in the sea floor so that when an ice floe comes against the ice-bending surface 41, the legs 25 actually hold the hull 20 down and force the bending of the ice floe and resist the lifting force of the ice floe which, in an extreme case, may lift the near side of the rig 10 and push the rig over on its side by using the feet 26 on the opposite side of the rig 10 as the fulcrum or pivot. The cans in the sea floor are known for other applications and the feet 26 would include appropriate connections to attach and release from the cans, as desired.

[0022] It should probably be noted that shifting from a conventional open water drilling configuration as shown in Figure 2 to a hull-in-water, ice defensive configuration shown in Figure 3 may require considerable planning and accommodation depending on what aspect of drilling is ongoing at the time. While some equipment can accommodate shifting of the height of the deck 21, other equipment may require disconnections or reconfiguration to adapt to a new height off the sea floor 15.

[0023] The ice-worthy jack-up drill rig 10 is designed to operate like a conventional jack-up rig in open water, but is also designed to settle to the water in an ice defensive position and then re-acquire the conventional stance or configuration when wave action becomes a concern. It is the shape of the hull 20 (as well as its strength) that provides ice bending and breaking capabilities.

[0024] The hull 20 preferably has a faceted or multi-sided shape that provides the advantages of a circular or oval shape, and may be less expensive to construct. The plates that make up the hull would likely be formed of flat sheets and so that the entire structure comprises segments of flat material such as steel would likely require less complication. The ice-breaking surface would preferably extend at least about five meters above the water level, recognizing that water levels shift up and down with tides and storms and perhaps other influences. The height above the water level accommodates ice floes that are quite thick or having ridges that extend well above the sea surface 12, but since the height of the shoulder 42 is well above the sea surface 12, the tall ice floes will be forced down as they come into contact with the rig 10. At the same time, the deck 21 at the top of the hull 20 should be far enough above the water line so that waves are not able to wash across the deck. As such, the deck 25 is preferred to be at least 7 to 8 meters above the sea surface 12. Conversely, the neckline 42 is preferred to be at least 4 to 8 meters below the sea surface 12 to adequately bend the ice floes to break them up into more harmless bits. Thus, the hull 20 is preferably in the range of 5-16 meters in height from the flat of bottom to the deck 20, more preferably 8-16 meters or 11-16 meters.

[0025] It should also be noted that the legs 25 and the openings 27 through which they are connected to the hull 20 are within the perimeter of the ice deflector 45 so that the ice floes are less likely to contact the legs while the rig 10 is in its defensive ice condition configuration as

shown in Figure 3 and sometimes called hull-in-water configuration. Moreover, the rig 10 does not have to handle every ice floe threat to significantly add value to oil and gas companies. If rig 10 can extend the drilling season by as little as a month, that would be a fifty percent improvement in some ice prone areas and therefore provide a very real cost saving benefit to the industry.

[0026] In closing, it should be noted that the discussion of any reference is not an admission that it is prior art to the present invention, especially any reference that may have a publication date after the priority date of this application. At the same time, each and every claim below is hereby incorporated into this detailed description or specification as an additional embodiment of the present invention.

[0027] Although the systems and processes described herein have been described in detail, it should be understood that various changes, substitutions, and alterations can be made without departing from the scope of the invention as defined by the following claims.

Claims

1. An ice-worthy jack-up rig (10) for drilling for hydrocarbons in potential ice conditions in offshore areas comprising:

a flotation hull (20) having a relatively flat deck (21) at the upper portion thereof and an ice-bending shape (41) along the lower portion thereof and extending downwardly and inwardly around the periphery of the hull where the ice-bending shape extends from an area of the hull near the level of the deck (21) and extends downwardly near the bottom of the hull;
an ice deflecting portion (45) extending around the perimeter of the bottom of the hull to direct ice around the hull and not under the hull;
at least three truss form legs (25) that are positioned within the perimeter of the bottom of the flotation hull (20) wherein the legs are arranged to be lifted up off the seafloor (15) so that the rig (10) may be towed through shallow water and also extend to the sea floor and extend further to lift the hull (20) partially or fully out of the water;
a jack-up device associated with each leg (25) to both lift the leg from the sea bottom so that the ice worthy jack-up rig may float by the buoyancy of the hull (20) and push the legs down to the seafloor and push the hull partially up and out of the water when ice floes (51, 52) threaten the rig and fully out of the water when ice is not present;
leg ice shields (32) arranged to protect the truss form legs (25) from ice (51, 52); and
a gas agitation system (35, 36, 28) to agitate the water near the legs (25) and reduce issues with ice near the legs.

2. The ice worthy jack-up rig according to claim 1, wherein the truss form legs (25) include vertical posts and cross members connecting the posts and the ice shields (32) are positioned between the posts to protect the cross members.

3. The ice worthy jack-up rig according to claim 1 or claim 2, wherein the ice bending surface (41) is slanted upwardly and outwardly from a smaller dimension neckline (44) to a larger dimension shoulder (42).

4. The ice worthy jack-up rig according to any preceding claim, wherein the ice bending surface (41) extends vertically at least 8 to 10 or more meters.

5. The ice worthy jack-up rig according to claim 4, wherein the angle of the ice-bending surface (41) is in the range of 30 to 60 degrees from the vertical.

6. The ice worthy jack-up rig according to any preceding claim, wherein the ice-bending surface (41) comprises a plurality of relatively flat, sloped, segments extending around the periphery of the rig.

7. The ice worthy jack-up rig according to any preceding claim, wherein the ice-bending surface (41) is a reinforced surface.

8. A method for drilling in ice prone waters using a rig in accordance with claim 1, the method comprising:

providing a rig (10) having a flotation hull (20) having a relatively flat deck (21) at the upper portion thereof and an ice-bending shape (41) along the lower portion thereof where the ice-bending shape extends from an area of the hull (20) near the level of the deck (21) and extends downwardly near the bottom of the hull and an ice deflecting portion (45) extending around the perimeter of the bottom of the hull (20) to direct ice (51, 52) around the hull (20) and not under the hull;
providing at least three truss form legs (25) that are positioned within the perimeter of the bottom of the hull where each leg comprises a plurality of vertically oriented posts connected by cross members and ice shields (32) are arranged between the posts to protect the cross members from ice (51, 52);
jacking down each leg (25) in a manner that feet (26) on the bottom of the legs (25) engages the sea floor and lifts the hull (20) up and fully out of the water when ice is not threatening the rig while the rig is drilling a well on a drill site;
lowering the hull (20) into the water into an ice defensive configuration so that the ice-bending

shape (41) extends above and below the sea surface to bend ice (51, 52) that comes against the rig (10) to cause the ice to submerge under the water and endure bending forces that break the ice where the ice flows past the rig; and agitating water near the legs (25) to reduce issues with ice near the legs.

9. The method according to claim 8 further including the step of anchoring the legs (25) to the seafloor to further resist the force of ice floes.

10. The method according to claim 8 or claim 9 wherein the ice-bending surface (41) extends from a shoulder (42) to a neckline (44) and the step of lowering the hull (20) into the water more particularly comprises lowering the hull into the water so that the neckline (44) is at least 4 meters below the sea surface and the shoulder is at least 7 meters above the sea surface.

11. The method according to any of claims 8 to 10 further including the step of raising the hull (20) up out of the water when the threat of ice floes are reduced.

12. A method for drilling in ice prone waters comprising the use of a rig (10) as claimed in any of claims 1 to 7.

Patentansprüche

1. Eine Eis-taugliche Hubplattform (10) zum Bohren nach Kohlenwasserstoffen in potentiell eisigen Konditionen in Offshore-Bereichen, aufweisend:

Einen Schwimmrumpf (20) mit einem verhältnismäßig flachen Deck (21) in seinem oberen Abschnitt und einer Eis-beugenden Form (41) entlang seinem unteren Abschnitt und sich abwärts und innenwärts entlang der Peripherie des Rumpfs erstreckend, wobei die Eis-beugende Form sich von einem Bereich des Rumpfes nahe der Ebene des Decks (21) her erstreckt und sich nach unten nahe des Bodens des Rumpfes erstreckt;

Einen Eis-ablenkenden Abschnitt (45), der sich um den Umfang der Unterseite des Rumpfes erstreckt, um Eis um den Rumpf herum und nicht unter den Rumpf zu lenken;

Mindestens drei Beine (25), die innerhalb des Umfangs der Unterseite des Schwimmrumpfes (20) angeordnet sind, wobei die Beine eingerichtet sind, um vom Meeresboden (15) weg angehoben zu werden, so dass die Plattform (10) durch flache Gewässer geschleppt werden kann, und sich bis zum Meeresboden erstrecken und sich weiter erstrecken, um den Rumpf (20) teilweise oder ganz aus dem Wasser zu heben;

Eine Hubvorrichtung, die mit jedem der Beine (25) verbunden ist, um sowohl das Beim vom Meeresgrund anzuheben, so dass die Eis-taugliche Hubplattform aufgrund der Auftriebskraft des Rumpfes (20) zu schwimmen vermag, als auch die Beine auf den Meeresboden herunter zu drücken und den Rumpf teilweise nach oben und aus dem Wasser heraus zu drücken, wenn Eisschollen (51, 52) die Plattform gefährden, und aus dem Wasser heraus zu drücken, wenn Eis nicht gegenwärtig ist;

Bein-Eis-Schilde (32) die eingerichtet sind, um die trägerförmigen Beine (25) vor Eis (51, 52) zu schützen; und

Ein Gas-Beunruhigungs-System (35, 36, 28), um das Wasser nahe der Beine (25) zu beunruhigen und Schwierigkeiten mit Eis in der nahe der Beine zu verringern.

2. Die Eis-taugliche Hubplattform nach Anspruch 1, wobei
die trägerförmigen Beine (25) Vertikalpfosten und die Pfosten verbindende Querelemente beinhalten, und die Eis-Schilde (32) zwischen den Pfosten angeordnet sind, um die Querelemente zu schützen.

3. Die Eis-taugliche Hubplattform nach Anspruch 1 oder Anspruch 2, wobei
die Eis-beugende Oberfläche (41) nach oben und außen hin, von einem kleiner dimensionierten Nackenausschnitt (44) zu einer zu einem größer dimensionierten Schulterausschnitt (42) abgeschrägt ist.

4. Die Eis-taugliche Hubplattform nach einem der voranstehenden Ansprüche, wobei
die Eis-beugende Oberfläche (41) der Plattform sich vertikal mindestens um weitere 8 bis 10 Meter erstreckt.

5. Die Eis-taugliche Hubplattform nach Anspruch 4, wobei
der Winkel der Eis-beugenden Oberfläche (41) der Plattform im Bereich von 30 bis 60 Grad von der Vertikalen liegt.

6. Die Eis-taugliche Hubplattform nach einem der voranstehenden Ansprüche, wobei
die Eis-beugende Oberfläche (41) eine Mehrzahl von verhältnismäßig flachen, geneigten Segmenten aufweist, die sich entlang der Peripherie der Plattform erstrecken.

7. Die Eis-taugliche Hubplattform nach einem der voranstehenden Ansprüche, wobei
die Eis-beugende Oberfläche (41) eine verstärkte Oberfläche ist.

8. Ein Verfahren zum Bohren eines Schachts in Eisanfälligem Gewässer unter Verwendung einer Plattform gemäß Anspruch 1, das Verfahren aufweisend:

Bereitstellen einer Plattform (10), aufweisend einen Schwimmrumpf (20) mit einem verhältnismäßig flachen Deck (21) in seinem oberen Abschnitt und einer Eis-beugenden Form (41) entlang seinem unteren Abschnitt, wobei die Eisbeugende Form sich von einem Bereich des Rumpfes (20) nahe der Ebene des Decks (21) her erstreckt und sich nach unten nahe des Bodens des Rumpfes erstreckt, und einen Eis-ablenkenden Abschnitt (45), der sich um den Umfang der Unterseite des Rumpfes (20) erstreckt, um Eis (51, 52) um den Rumpf (20) herum und nicht unter den Rumpf zu lenken.
Bereitstellen von mindestens drei trägerförmigen Beinen (25), die innerhalb des Umfangs der Unterseite des Rumpfes angeordnet sind, wobei jedes Bein eine Mehrzahl von vertikal orientierten Pfosten aufweist, die durch Querelemente verbunden sind und Eis-Schilde (32) zwischen den Pfosten angeordnet sind, um die Querelemente vor Eis (51, 52) zu schützen;
Herunterdrücken jedes Beins (25) in einer Weise, dass Füße (26) am Ende der Beine (25) den Meeresboden berührt und die den Rumpf (20) nach oben und ganz aus dem Wasser heraushebt, wenn Eis die Plattform nicht gefährdet während die Plattform einen Schacht an einer Bohrstelle bohrt;
Absenken des Rumpfes (20) ins Wasser in eine Eisabwehrende Konfiguration, so dass die Eisbeugende Form (41) sich oberhalb und unterhalb der Meeresoberfläche erstreckt um Eis (51, 52), das gegen die Plattform (10) kommt, derart zu beugen, dass das Eis unter Wasser abtaucht und Beugekräfte aufrecht erhalten werden, die das Eis brechen, wo das Eis entlang der Plattform strömt; und
Beunruhigen des Wassers nahe der Beine (25), um Schwierigkeiten mit Eis in der nahe der Beine zu verringern

9. Das Verfahren nach Anspruch 8, weiter aufweisend den Schritt des Verankerns der Beine (25) am Meeresboden um den Kräften von Eisschollen weiter zu widerstehen.

10. Das Verfahren nach Anspruch 8 oder Anspruch 9, wobei die Eis-beugende Oberfläche (41) sich von einem Schulterausschnitt (42) zu einem Nackenausschnitt (44) erstreckt und der Schritt des Herabsenkens des Rumpfes (20) ins Wasser insbesondere das Herabsenken des Rumpfes ins Wasser aufweist, so dass der Nackenausschnitt (44) mindestens 4 Meter unterhalb der Meeresoberfläche ist und der Schulterabschnitt mindestens 7 Meter oberhalb der Meeresoberfläche ist.

11. Das Verfahren nach einem der Ansprüche 8 bis 10, weiter den Schritt des Hochhebens des Rumpfes (20) aus dem Wasser heraus, wenn die Gefahr von Eisschollen verringert ist, beinhaltend.

12. Ein Verfahren zum Bohren in Eis-anfälligem Gewässer, die Verwendung einer Plattform (10) wie in einem der Ansprüche 1 bis 7 beansprucht, aufweisend.

Revendications

1. Barge de forage autoélévatrice (10) adaptée à la glace pour forer des hydrocarbures dans des conditions de glace potentielle dans des zones offshore, comprenant :

une coque de flottaison (20) ayant un pont relativement plat (21) dans sa partie supérieure et une forme ployant la glace (41) le long de sa partie inférieure et s'étendant vers le bas et l'intérieur autour de la périphérie de la coque, où la forme ployant la glace s'étend d'une zone de la coque proche du niveau du pont (21) et s'étend vers le bas à proximité du fond de la coque ;
une partie de déviation de la glace (45) s'étendant autour du périmètre du fond de la coque pour diriger la glace autour de la coque et non en dessous de la coque ;
au moins trois jambes en forme de fermes (25) qui sont positionnées dans le périmètre du fond de la coque de flottaison (20), dans laquelle les jambes sont aménagées pour être soulevées du lit de la mer (15) de sorte que la barge (10) puisse être remorquée en eau peu profonde et s'étende également jusqu'au lit de la mer et s'étende par ailleurs pour soulever la coque (20) en partie ou en totalité hors de l'eau ;
un dispositif autoélévateur associé à chaque jambe pour à la fois soulever la jambe du fond de la mer de sorte que la barge autoélévatrice adaptée à la glace puisse flotter du fait de la flottabilité de la coque (20) et repousser les jambes vers le bas sur le lit de la mer et pousser la coque en partie vers le haut et en dehors de l'eau lorsque des glaces flottantes (51, 52) menacent la barge et complètement en dehors de l'eau lorsqu'il n'y a pas de glace ;
des protections anti-glace (32) pour les jambes aménagées pour protéger les jambes en forme de fermes (25) des glaces flottantes (51, 52) ; et
un système d'agitation à gaz (35, 36, 28) pour agiter l'eau à proximité des jambes (25) et ré-

duire les problèmes avec la glace à proximité des jambes.

2. Barge de forage autoélévatrice adaptée à la glace selon la revendication 1, dans laquelle les jambes en forme de fermes (25) comprennent des montants verticaux et des traverses raccordant les montants et les protections anti-glace (32) sont positionnés entre les montants pour protéger les traverses.

3. Barge de forage autoélévatrice adaptée à la glace selon la revendication 1 ou la revendication 2, dans laquelle la surface ployant la glace (41) est inclinée vers le haut et vers l'extérieur à partir d'une ligne d'étranglement de plus petite dimension (44) à un épaulement de plus grande dimension (42).

4. Barge de forage autoélévatrice adaptée à la glace selon l'une quelconque des revendications précédentes, dans laquelle la surface ployant la glace (41) s'étend verticalement sur au moins 8 à 10 mètres ou plus.

5. Barge de forage autoélévatrice adaptée à la glace selon la revendication 4, dans laquelle l'angle de la surface ployant la glace (41) se situe dans la plage de 30 à 60 degrés par rapport à la verticale.

6. Barge de forage autoélévatrice adaptée à la glace selon l'une quelconque des revendications précédentes, dans laquelle la surface ployant la glace (41) comprend une pluralité de segments inclinés relativement plats s'étendant sur la périphérie de la barge de forage.

7. Barge de forage autoélévatrice adaptée à la glace selon l'une quelconque des revendications précédentes, dans laquelle la surface ployant la glace (41) est une surface renforcée.

8. Procédé de forage dans des eaux enclines à la présence de glace en utilisant une barge de forage selon la revendication 1, le procédé comprenant les étapes consistant à :

fournir une barge de forage (10) ayant une coque de flottaison (20) ayant un pont relativement plat (21) dans sa partie supérieure et une forme ployant la glace (41) le long de sa partie inférieure, où la forme ployant la glace s'étend d'une zone de la coque (20) proche du niveau du pont (21) et s'étend vers le bas à proximité du fond de la coque et une partie de déviation de la glace (45) s'étendant autour du périmètre du fond de la coque (20) pour diriger la glace (51, 52) autour de la coque (20) et pas en dessous de la coque ;
fournir au moins trois jambes en forme de fermes (25) qui sont positionnées dans le périmètre du fond de la coque, où chaque jambe comprend une pluralité de montants verticalement orientés raccordés par des traverses et des protections anti-glace (32) sont aménagés entre les montants pour protéger les traverses de la glace (51, 52) ;
faire descendre chaque jambe (25) de manière que les pieds (26) qui se trouvent au fond des jambes (25) s'engagent sur le lit de la mer et soulèvent la coque (20) vers le haut et complètement en dehors de l'eau lorsque la glace ne menace pas la barge de forage, tandis que la barge de forage fore un puits sur un site de forage ;
abaisser la coque (20) dans l'eau en configuration défensive à l'égard de la glace de sorte que la forme ployant la glace (41) s'étende au-dessus et au-dessous de la surface de la mer pour ployer la glace (51, 52) qui vient contre la barge de forage (10) afin d'amener la glace à s'immerger en dessous de l'eau et à subir des forces de flexion qui brisent la glace lorsque la glace s'écoule au-delà de la barge de forage ; et
agiter l'eau à proximité des jambes (25) pour réduire les problèmes avec la glace proche des jambes.

9. Procédé selon la revendication 8, comprenant en outre l'étape d'ancrage des jambes (25) sur le lit de la mer pour encore résister aux forces des glaces flottantes.

10. Procédé selon la revendication 8 ou la revendication 9, dans lequel la surface ployant la glace (41) s'étend d'un épaulement (42) à une ligne d'étranglement (44) et l'étape d'abaissement de la coque (20) dans l'eau comprend plus particulièrement l'abaissement de la coque dans l'eau de sorte que la ligne d'étranglement (44) soit au moins 4 mètres en dessous de la surface de la mer et que l'épaulement se situe au moins 7 mètres au-dessus de la surface de la mer.

11. Procédé selon l'une quelconque des revendications 8 à 10, comprenant en outre l'étape de soulèvement de la coque (20) hors de l'eau lorsque les craintes de glaces flottantes sont réduites.

12. Procédé de forage dans des eaux enclines à la présence de glace comprenant l'utilisation d'une barge de forage (10) selon l'une quelconque des revendications 1 à 7.

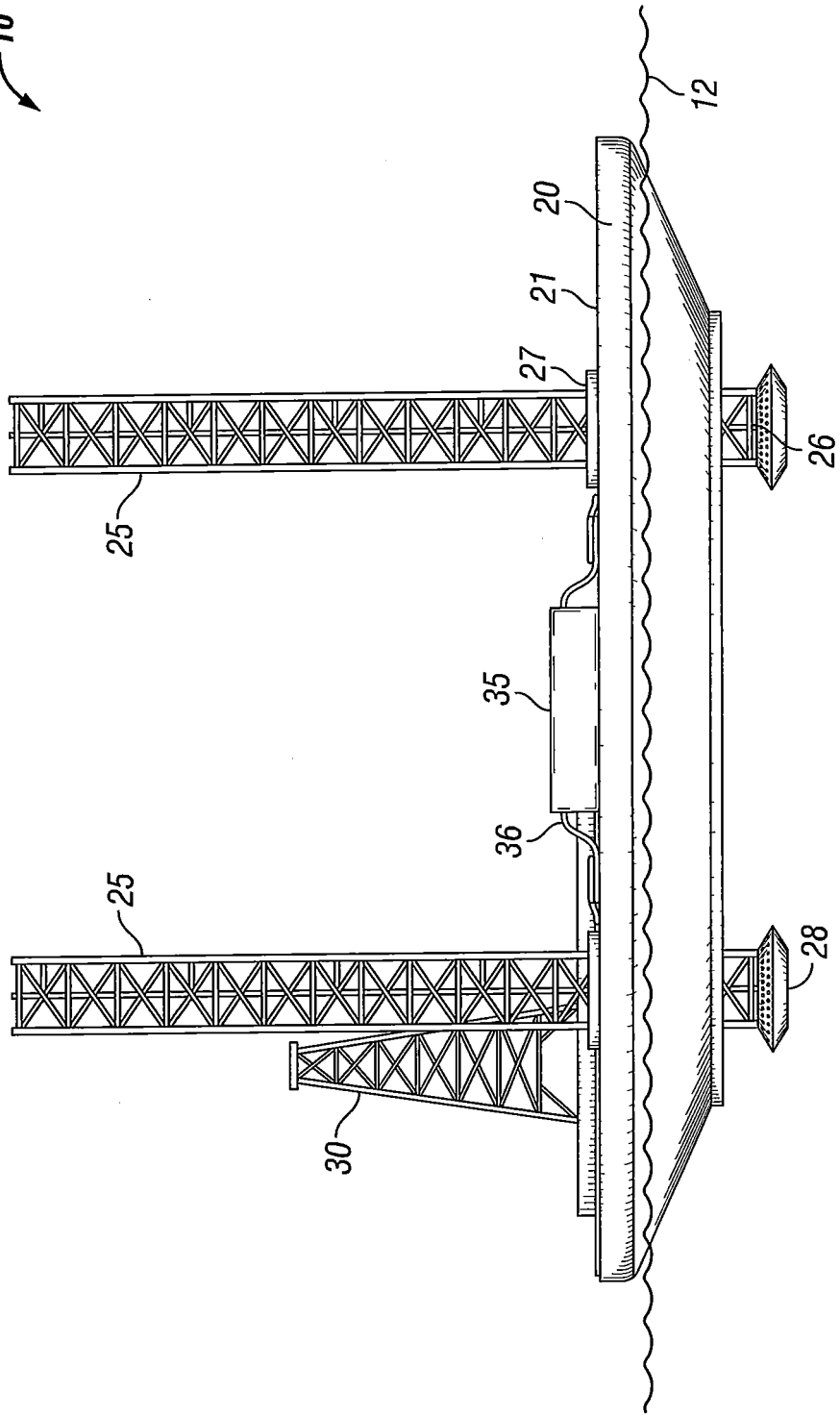

FIG. 1

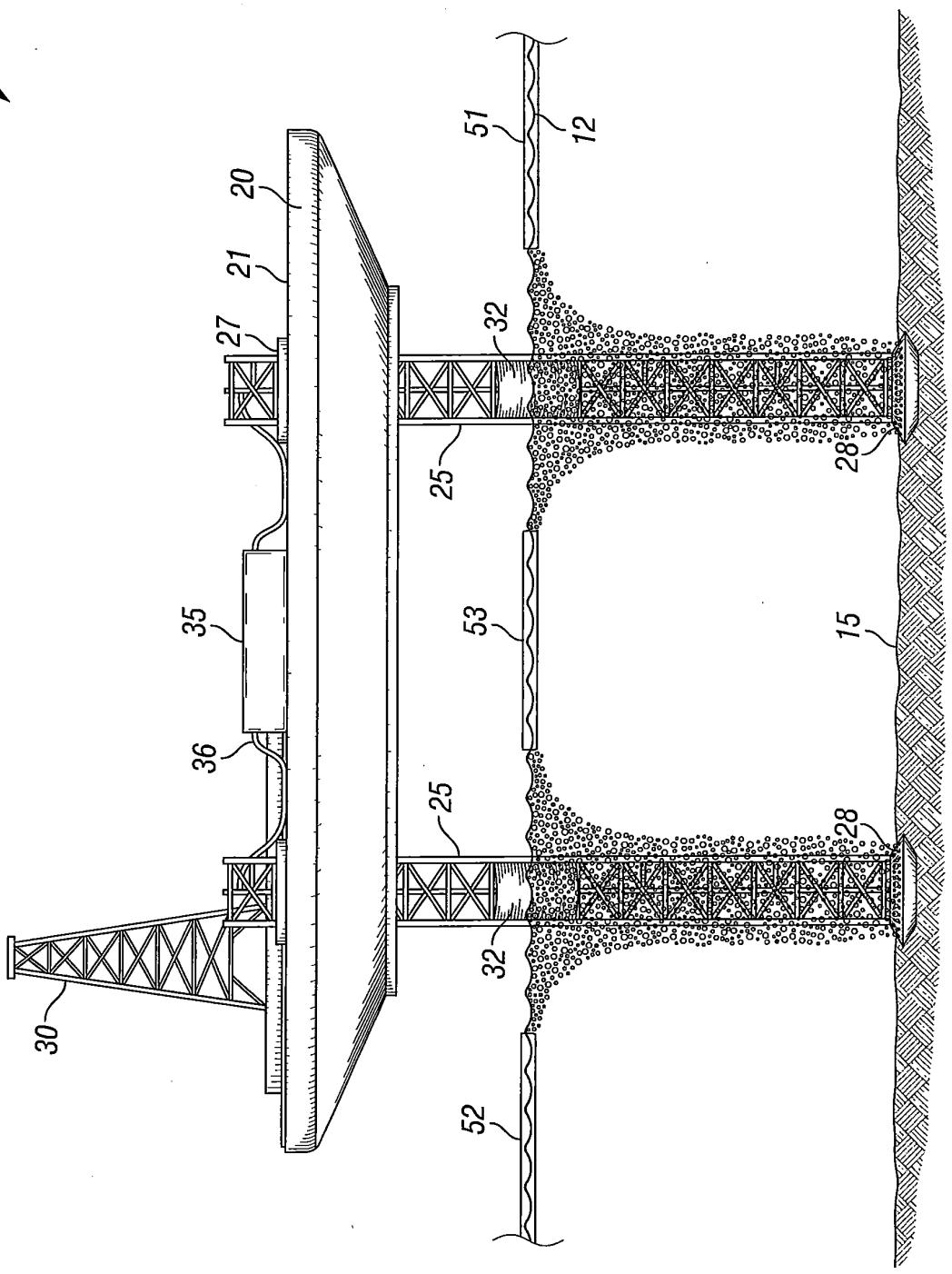

FIG. 2

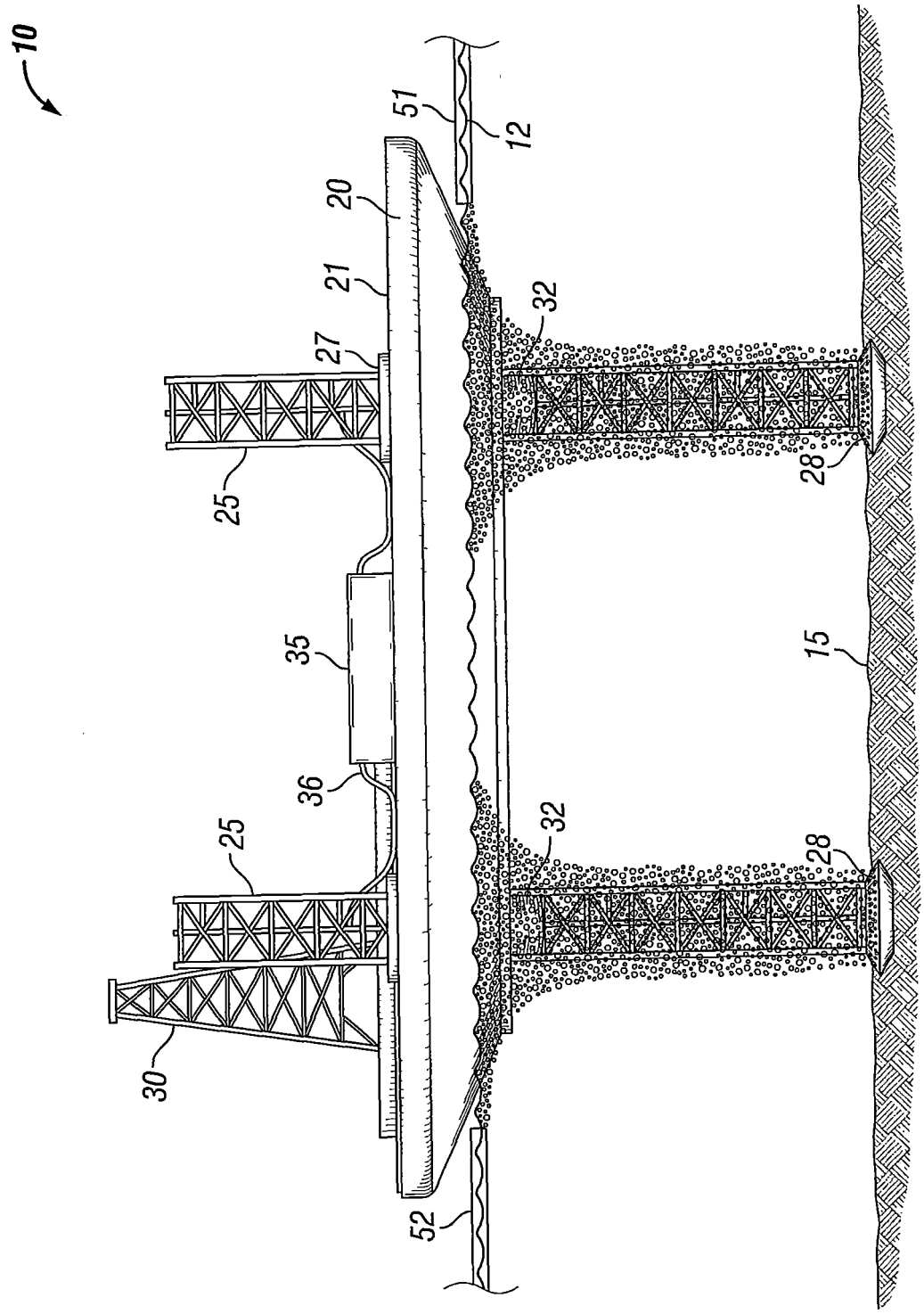

FIG. 3

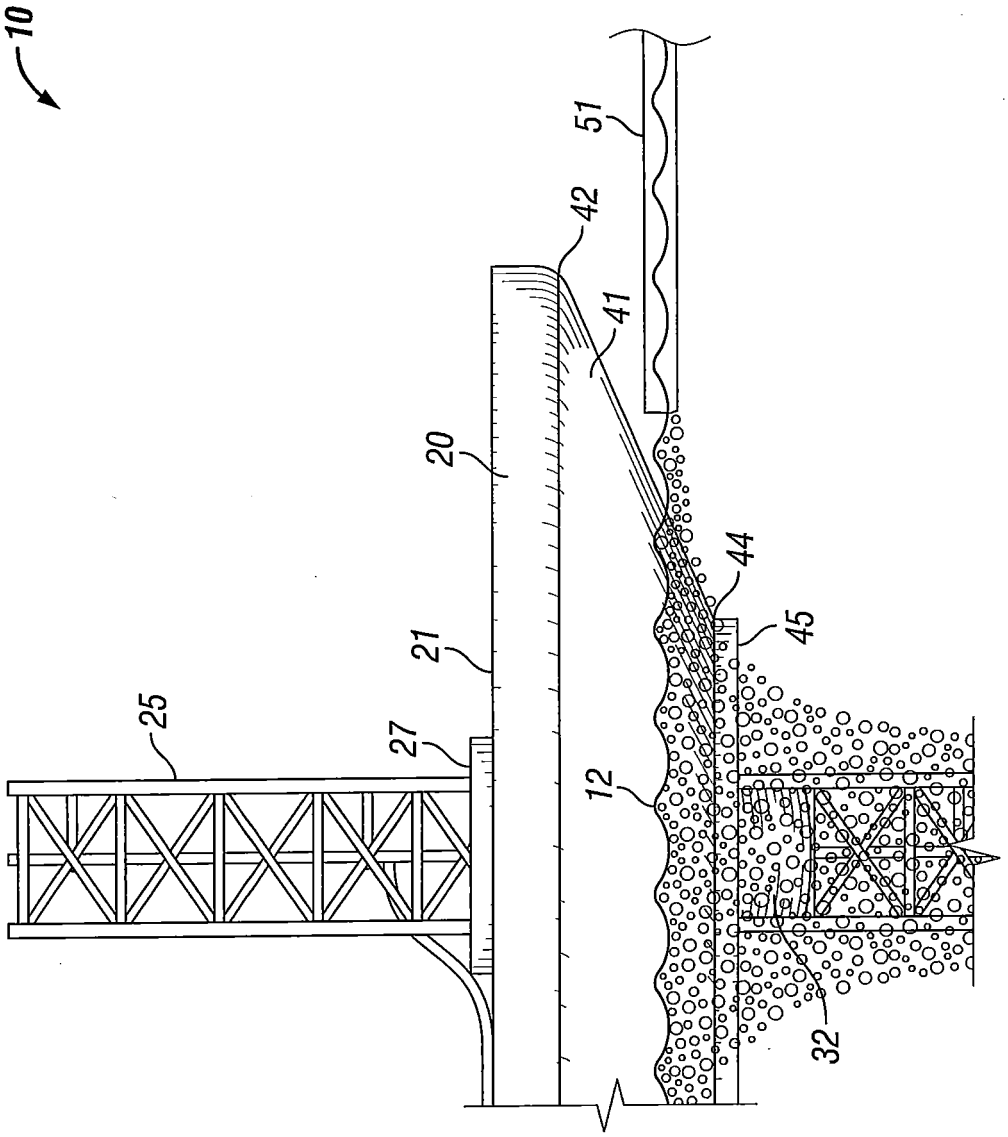

FIG. 4

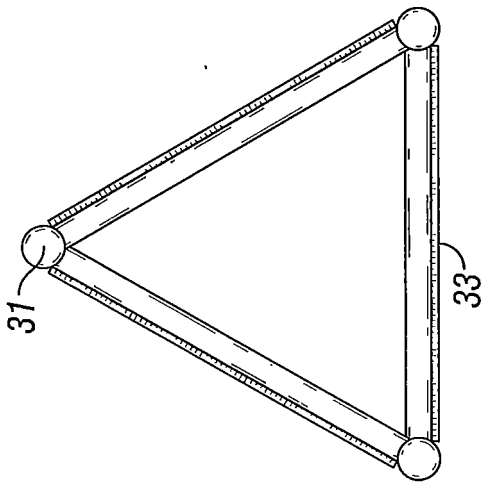

FIG. 6

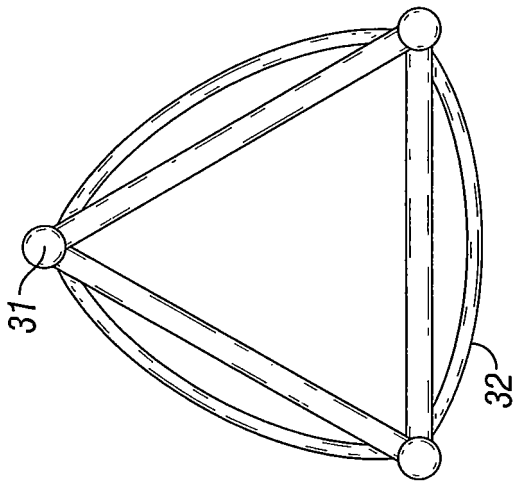

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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